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[No. I.]

Studies in the Typhaceæ.

BY THOMAS MORONG.*

I.—TYPHA.

Historically *Typha* and *Sparganium* have come down in unbroken descent from Tournefort. First collectively named Typhæ by Jussieu, next Typhinæ by Agardh, and finally Typhaceæ by De Candolle, they are divided by Bentham and Hooker into the two tribes, Typheæ and Sparganiaceæ, each represented by a single genus.

Typha is more nearly related to the Aroideæ than its congener *Sparganium*, because it possesses organs which represent both spadix and spathe. If the inflorescence is gathered when young, it will be found that the spikes are wrapped in a membranaceous sheath attached to their base and rising above the summit in a leaf-like blade. This is commonly called a bract, but in reality it is a spathe or answers the purpose of one to the young spikes. It encloses several thinner sheaths, one for each spike, and generally two or three others which spring at intervals from different points in the spikes, as though these were made up of successive joints. To be seen at all, the bracts must be taken in the early anthesis, as they are caducous, and wither and fall off even before the anthers are ready to shed their pollen. This habit of *Typha* in separating its spikes into several partitions by the intervention of bracts, shows a curious relationship between it and *Sparganium*. In the latter the process has gone farther, and there is a distinct separation of the spikes into small heads, some

* Special thanks are due to the botanists to whose courtesy I am indebted for much of the material used in the preparation of these papers. Dr. Gray and Dr. Watson, of Cambridge, have rendered invaluable aid in friendly counsel and encouragement, and in permitting the free use of the Harvard Herb. and botanical library. I am also much indebted for the loan of specimens to Dr. N. L. Britton, Mr. W. M. Canby, Prof. E. L. Greene and Prof. John Macoun.

distance apart, the pistillate below and the staminate above—each, except the very uppermost, subtended by a floral leaf or bract. As in *Typha* the division is most numerous in the staminate spike, so it is in *Sparganium*, where we find only from one to six pistillate heads, and from two to thirty or more staminate.

The inflorescence of *Typha* is much more complicated than that of any of the Aroideæ, or, at least, of any of the North American members of that order; and the inflorescence of *Sparganium* is simplicity itself in comparison.

It might be suspected, perhaps, that an arrangement of this type would be attended by various irregularities and monstrosities, and such is really the case. For one thing, the inflorescence varies indefinitely, even in the same species, in dimensions. Mature spikes not over an inch or two in length are found, and from this dwarfed condition they extend to a length of 12 or 14 inches, and the entire inflorescence varies from 5 inches to 3 feet long. A similar variation occurs in the diameter of the spikes; some of them are not as thick as an ordinary goose-quill, while others measure nearly an inch and a half through.

A naked space between the pistillate and staminate spikes was formerly regarded as a sufficient distinction between certain species, as, for instance, between *T. latifolia* and *T. angustifolia*, but here, too, a great variation exists, so that this mark cannot be relied upon at all as a ground of specific distinction. It is true that *T. angustifolia* does ordinarily exhibit such an interval, and perhaps thousands of plants in the same locality will be thus characterized, but in another locality the spikes will frequently be continuous. The same variation occurs in *T. latifolia*.

The inflorescence, also, is often interrupted in various ways. Two pistillate or two staminate spikes not rarely occur on the same plant, and even two of each kind on the same stem. When this takes place in *T. latifolia*, it is generally in the staminate spike, and the abnormal addition looks like a small Turk's-cap set on the end. In several instances I have seen a double spiked stem in which one of the spikes occupied only one-half the diameter of the rachis. Besides this irregularity, both kinds of flowers will not unfrequently be mingled in patches along the same spike, occurring generally in the pistillate spike.

Akin to such external eccentricities is a difference in the character of the pollen. Some of the species, like *T. angustifolia* and its near allies, have the pollen in single grains, varying in size from $\frac{1}{1250}$ inch to $\frac{1}{750}$ inch, while in *T. latifolia* and *T. Laxmanni* the pollen is united in fours. The outlines of the four cells may be readily discerned under the microscope; and in some cases the grains are partially and occasionally wholly disintegrated, showing that the union is merely mechanical.

The floral organs are curious structures. They consist of numerous hair-like bodies, fertile and sterile, and densely crowded together in a compact mass upon the rachis. The stamens are single or most commonly 2-7 anthers united upon a connate capillary filament (see fig. 1). By grasping the anthers when fresh, they may be pulled apart and the filament torn into separate threads, showing, as in the case of the pollen, that the union is mere adherence.

Surrounding the stamens in all the species which I have examined are what in our ignorance of their use are commonly called *bracts*, or sometimes simply *hairs*. (See figures 1, 8, 9). When much magnified, these bodies appear to be naked, loosely cellular threads or ribbons, expanding upwards cuneately, or with a small clavate or spatulate tip which terminates in one or more projecting hairs. (See figures 10 and 11). I confess that these so-called male bracts seem to me more like imperfect pistillate flowers, bearing spatulate-lanceolate stigmas, than like bracts. Similar bodies occur in the pistillate inflorescence of some of the species. They bear no appearance of being transformed leaves. They do not seem to serve a protective purpose. It would accord with our modern evolutionary ideas to regard them as disused and degraded organs, their former utility having passed to the fertile flowers of the pistillate inflorescence, owing to the superior advantages of the latter for cross-fertilization.

The fertile flowers consist of a single capillary pistil, the ovary more or less stipitate, the style short and terminated by a rhomboid, spatulate or linear stigma, as shown in fig. 4. The calyx is composed of numerous (20-40) white, delicate setæ girding the base of the stipe, and of different lengths in the different species. Very much magnified, these setæ present the appearance shown

in fig. 7, tape-like bodies, having several rows of elongated cells, which are apparently knotted at their junction.

Mingled with the fertile flowers are many rudimentary flowers, if we may regard them as such, which in some instances resemble the fertile in shape and size, but generally much shorter and club-shaped at the summit, which also are surrounded at the base by perigonial setæ, but show no trace of an ovary. (See figures 2, 4 and 13). In many of the species mixed with the fertile and sterile flowers are very slender bracts like those described above as occurring in the staminate spike. (See figures 5, 14). The stigmas and ends of the bracts are of a rusty tinge, and their projecting tips impart the well-known hues of dark and light brown to the spikes.

So closely packed are the flowers, that I have counted, within the distance of an eighth of an inch, in a pistillate spike of *T. angustifolia*, over 1,500 ripe fruit, besides the accompanying sterile flowers and bracts. Therefore a fruiting spike 5 inches in length, an average size, must yield, at the lowest calculation, a crop of 60,000 seeds; and as spikes 7 and 8 inches long are not unfrequent, the yield in some cases will be half as many more. When taking to the air the perigonial setæ expand, as shown in fig. 3, and the seed sails away on a balloon like thistle down. Think, then, of one plant committing to the winds nearly 100,000 seeds; and try to estimate the enormous number that must be produced in the acres covered by a single *Typha* jungle like that on the Hackensack meadow, near the city of New York!

The plants of the *Typha* family serve several uses which are worthy of notice. Sir Joseph Hooker states that the inhabitants of Scind and New Zealand make bread from the pollen. As this is very abundant, falling like meal out of a bag at the time of fertilization, we can easily imagine it capable of such a use. The roots might perhaps be employed in a similar manner, if dried and ground into flour, as they are farinaceous and often quite long.

Prof. W. R. Dudley states that in central New York the long leaves are used quite extensively in the manufacture of chair-bottoms; they are also woven into baskets, for which they are

well fitted. In decorative art all are familiar with the panel pictures and the mantel ornamentation in which our common cat-tail plays so conspicuous a part.

The most natural classification of the species of *Typha* that I have seen is the arrangement of Dr. P. Rohrbach, of Berlin, published about the year 1870.* As this paper has never been translated into English, so far as I am aware, except in the abstract of it given by Dr. Engelman,† it may be new to most readers of the BULLETIN. I therefore reproduce Rohrbach's summary, so that our North American species may be assigned to their proper places :

A.—FRUIT WITH A LONGITUDINAL FURROW, BURSTING IN WATER ;
SEED WITH A SEPARABLE OUTER COAT.

I.—STIGMAS SPATULATE-LANCEOLATE.

- a. Female flowers without bracts.
 - 1. Stigmas longer than the perigonial hairs.
T. latifolia, L. *T. Capensis*, Rohrbach.
 - 2. Stigmas as long as the perigonial hairs.
T. Shuttleworthii, Koch et Sond.
- b. Female flowers with bracts.
 - 1. Stigmas longer than the perigonial hairs.
T. Schimperii, Rohrb.
 - 2. Stigmas as long as the perigonial hairs.
T. Muellerei, Rohrb.

II.—STIGMAS LINEAR.

- a. Female flowers without bracts.
T. glauca, Godr.
- b. Female flowers with bracts.
 - 1. Bracts and perigonial hairs of the same length.
T. angustifolia, L. *T. Domingensis*, Pers. *T. Javanica*, Schnitz.
 - 2. Bracts longer than the perigonial hairs, nearly as long as the stigmas.
T. angustata, Bory et Chaub.

B.—FRUIT WITHOUT A LONGITUDINAL FURROW, NOT BURSTING IN
WATER ; SEED WITH OUTER COAT NOT SEPARABLE.

I. STIGMAS SPATULATE-LANCEOLATE—FEMALE FLOWERS WITHOUT BRACTS.

T. stenophylla, F. et M.

II. STIGMAS LINEAR—FEMALE FLOWERS WITHOUT BRACTS.

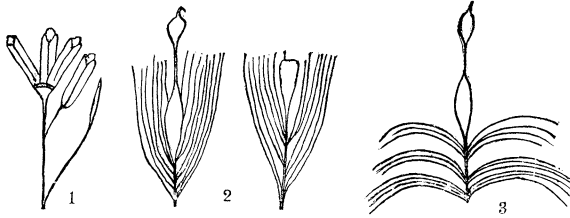
T. Laxmanni, Lepech.

T. Haussknechtii, Rohrb.

* Verhändl. Bot. Verein, Brandenb. xi., 67.

† Am. Jour. Sc. and Arts for Nov., 1871.

Of the species here enumerated only three are found within the limits of North America, the most widespread being:



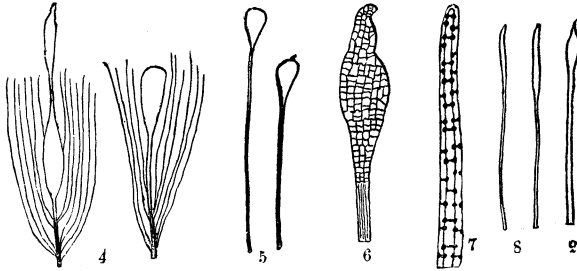
T. latifolia.—1. Staminate flower, with bract attached, X 3. 2. Fertile and sterile flower, X 3. 3. Ripe fruit of do. after leaving the spike, X 3.

1. *T. latifolia*, (L. sp. 1377). (Figs. 1-3).

This is too well known to need description. It may ordinarily be distinguished by its blackish color when ripe, and by the contiguity of the spikes, though neither these nor the breadth of the leaves should be relied upon. The absence of bracts from its pistillate spikes, its spatulate stigmas and four-grained pollen, are the most satisfactory tests. At maturity the flower stems separate from the lower part of the stalk, leaving the rachis covered with coarse, reddish bristles about 1 line in length. Otherwise the surface of the rachis is smooth.

The species is found throughout North America.

“Var. *elongata*.” W. R. Dudley, Cayuga Flora, p. 102. Of this form I have not been able to obtain a specimen for examination. Prof. Dudley states that its fruiting spike is sometimes as much as 12 inches in length; but if only the length of the spike is considered, that would hardly warrant even a varietal distinction.



Typha angustifolia.—4. Fertile and sterile flower, X 10. 5. Pistillate bracts, X 10. 6. Style, highly magnified. 7. Perigonal seta, highly magnified. 8, 9. Staminate bracts, X 10.

2. *T. angustifolia*, (L. sp. 1377, Excl. var. β). (Figs. 4-9).

This species is much more limited in its range than the pre-

ceding. It is not reported north of the U. S. and Canada line, and in the South only in Louisiana, and westward to California. Personal observation and an examination of many local catalogues lead me to think that it is mainly a seaside species, and rather rare in the interior of the country. It covers extensive swamps along our northern Atlantic seaboard.

This species may be easily distinguished from *T. latifolia* by its light brown color, its simple pollen, its linear stigmas and female bracts. Rohrbach describes the bracts as shorter than the stigmas, but in our N. A. forms the two are frequently of the same length. (See fig. 5). The denuded rachis is rough, with stiff points, which are the bases of the fallen flowers.



T. Domingensis.—10. Staminate bracts, X 8. 11. Do. of a specimen from Buenos Ayres, X 8. 12, 13, 14. Fertile and sterile flower and pistillate bract, each X 10.

3. *T. Domingensis*, Pers. (Syn., ii, 532.) (*T. angustifolia*, L., sub.-sp. *Domingensis*, Rohrb.) (Figs. 10-14).

Though closely allied to *T. angustifolia*, yet this plant possesses some distinctive specific features. Pollen simple, often as small as $\frac{1}{16}$ inch in diam.; male bracts often as long as the anthers, thick cuneate or broad spatulate at the summit, much larger than in *T. angustifolia* (figures 10, 11); female bracts delicate, with a small, rounded or spatulate head, as long as the stigmas (fig. 14); perigonial setæ shorter than the stigmas, thickened upward near the summit (figs. 12, 13). This is a very vigorous grower, and sometimes even gigantic in size. Prof. E. L. Greene describes specimens* (*T. bracteata*, Greene, Bull. Cal.

*The plant so named by Mr. Greene, although the monarch of its tribe, is clearly to be placed here, as it exhibits all the diagnostic marks, especially the strap-shaped male bracts and the club shaped setæ, ascribed by Rohrbach to *T. Domingensis*. The characters relied upon by Mr. G. in naming, are its spathaceous bracts, a feature common to all the species, and its great size, which in itself certainly cannot be a sufficient ground for specific distinction. There is a specimen from Guarajuato, Mexico, in Herb. Gray, which has an inflorescence measuring over all some 32 inches, nearly as long as that of the plant from Santa Cruz.

Ac. Sc., ii, 413) which he collected on the Island of Santa Cruz, coast of California, as being from 15 to 18 feet in height, and bearing an inflorescence which in the largest specimens measures 3 feet in the aggregate length of the spikes. In other respects, like *T. angustifolia*.

This form has been reported as occurring in Texas, and it is found in Mexico, throughout the West India Islands, and near Buenos Ayres, S. America.

New or Little Known Grasses, I.

Plate LXXVI.

The following species of grasses have been known for some years in herbaria, but have remained until this time without published descriptions.

1. MUHLENBERGIA ARIZONICA, Scrib. (A, figs. 1-6). Culms densely tufted, 15-35 cm. high, including panicle, which is from 8-18 cm. long, with a habit as represented in figure 1. Leaves 3-5 mm. long by 1-1½ mm. broad, flat, many nerved and minutely scabrous on the margins, especially near the very acute tips. Ligule short. Panicle ovate in outline, branches very slender and few-flowered, pedicels minutely scabrous. Spikelets about 3 mm. long, empty glumes nerveless, obtuse, nearly equal, slightly over 1 mm. in length; flowering glume finely pubescent on the margins and dorsal nerve near the base, minutely two-toothed at apex and bearing a short (½ mm.) awn.

Mesas, near the Mexican boundary, Pringle, 1884, and No. 402 Pringle, "*Plantæ Mexicanæ*," 1885.

2. SPOROBOLUS INTERRUPTUS, Vasey (B, figs. 1-5). Culms densely cæspitose from a strong fibrous root, usually about 40 cm. high, including the lead colored panicle, which is from 10-18 cm. long with a habit as represented in figure 1. Culm leaves two, the lower about 8 cm. long, the upper somewhat shorter; flat, 2 mm. wide or less, very finely scabrous above and along the margins, especially towards the narrow and somewhat pungent tips. Ligule a ciliate fringe with a few long hairs at the margins. Spikelets often glomerated along the ascending branches, 6-7 mm. long; empty glumes broadly lanceolate, acute, the first about 3 and the second about 5 mm. long; flowering glume a